I. Project Title: Non-native Fish Control in Backwater Habitats in the Colorado River

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III. Project Summary:

The purpose of this study was to evaluate seining as a method for removing small, non-native cyprinids from backwaters and other low-velocity habitats. The study has progressed on schedule. Backwaters were sampled within two reaches of the upper Colorado River near Grand Junction, Colorado, the 15-mile reach, and the 18-mile reach. Sampling was conducted in late June and early July in 1999, and in early March and late April, 2000. Depletion estimates were made of non-native fishes in backwaters, and catch-per-effort was compared among sample passes and with data from the Interagency Standardized Monitoring Program (ISMP) for the same reaches gathered in September 1999. Comparisons will also be made with ISMP data gathered in September 2000, when those data are available early in the year 2001.

IV. Study Schedule: Initial Year = 1999; Final Year = 2001.

V. Relationship to RIPRAP: Task Number III.A.5: Remove small non-native cyprinids from backwaters and other low-velocity habitats.

VI. Accomplishment of FY00 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Task 1: Sampling and Removal of Fish

Sampling was conducted over two periods in 2000: in early March, when flows ranged between 1,860 cfs and 2,870 cfs, and in late April, when flows ranged between 2,150 and

7,590 cfs (Table 1). The original sampling design called for sampling in March, prior to spring runoff; however, backwater conditions resulted in the decision to shorten the March sampling period and return in late April. The relatively steady flows that prevailed from fall to early spring resulted in stable backwater conditions that allowed the formation of extremely high silt and algae content. This made a number of backwaters difficult or even impossible to seine as silt levels were too deep (up to one meter) for biologists to effectively pull the seine through the entire length of the backwater. In addition, large amounts of algae would become attached to the sides of the seine, making it laborious to sift the silt out of the seine. In a number of instances, the silt and algae mixture left in the seine was poured onto shore and then searched by hand to pull out individual fish. Seining conditions were better in the shallow backwaters with cobble substrates, generally near the main channel. However, fish numbers were still low, possibly due to low water temperatures (as low as 8°C). Consequently, sampling efforts were shortened in March to be completed in April. River flows had increased in late April, primarily in the 18-mile reach, scouring the backwaters and improving sampling conditions. Water temperatures had also increased in April. The intent of the original sampling design in March was to precede spawning by Colorado pikeminnow and razorback sucker to minimize the risk of killing or injuring the young fish during sampling. This goal was still achieved by sampling in late April, during the beginning of the spring runoff.

Table 1. Dates and river flow levels (cfs) for Spring 2000 sampling efforts.

March 2000 Sampling Efforts			April 2000 Sampling Efforts		
Date	15-mile reach (cfs)	18-mile reach **(cfs)**	Date	15-mile reach (cfs)	18-mile reach (cfs)
March 9, 2000	2010	2870	April 25, 2000	2170	5570
March 10, 2000	1990	2930	April 26, 2000	2150	5610
March 11, 2000	1930	2830	April 27, 2000	2250	5860
March 12, 2000	1900	2730	April 28, 2000	2810	6510
March 13, 2000	1750	2720	April 29, 2000	3660	7590
March 14, 2000	1890	2580	April 30, 2000	3890	7910
March 15, 2000	1860	2660			

Flow data taken from USGS gauging stations: Below Grand Valley Diversion Dam/Palisade (15-mile reach) and Near Colorado/Utah State Line (18-mile reach)

Five passes were made in each reach, with each pass taking 1-2 days. Three passes were made in March, and two in April. A total of 58 backwaters were sampled during the spring 2000 study: 35 in March and 23 in April. Some were repeatedly seined during the sampling period. Twenty-nine of the backwaters were located in the 15-mile reach and 29 in the 18-mile reach (Table 2). Of the 58 backwaters, seine samples from 6 had 50% or more native fishes, samples from 33 had fewer than 50% native fishes, while samples from 19 backwaters contained no fish. Only backwaters containing fish (non-zero) and those with greater 50%

non-natives were used in the analysis. A total of 7,054 (95.4%) non-native fish were removed from these backwaters, and 342 (4.6%) native fish were released.

Table 2. Number of backwaters sampled with and without a predominance of native fishes in the two reaches of the Colorado River near Grand Junction, Colorado (Spring 2000).

Reach[1]	≥50% Natives	<50% Natives	No Fish	Totals
15-Mile	4	14	11	29
18-Mile	2	19	8	29
Totals	6	33	19	58

[1]15-Mile Reach = River Mile 171.0-185.4 (Gunnison River to Grand Valley Diversion)
18-Mile Reach = River Mile 152.0-171.0 (Loma Boat Launch to Gunnison River)

Task 2: Interim Progress Report

An interim progress report was submitted to the Colorado Division of Wildlife on August 3, 2000. That report contained a summary of data collected and a preliminary analysis of total numbers and biomass of fish in backwaters.

Task 3: Annual Progress Report

A total of 7,396 fish comprising 16 different species were captured in backwaters during this study (includes only backwaters with <50% native fishes). Five native species were collected (flannelmouth sucker, *Catostomus latipinnis*; bluehead sucker, *C. discobolus*; razorback sucker, *Xyrauchen texanus*; roundtail chub, *Gila robusta*; and speckled dace, *Rhinichthys osculus*) and 11 non-native species. Two razorback suckers were captured in March, one in the 15-mile reach (total length 150 mm; RM 175.5) and one in the 18-mile reach (total length 235 mm; RM 163.8). While the razorback sucker is federally listed as endangered, these two specimens were probably reared in captivity and released by the United States Fish and Wildlife Service. A PIT tag reader was taken on subsequent seining efforts to determine if captured razorback suckers were PIT tagged, but no more razorback suckers were captured. The most common fishes captured were fathead minnows (*Pimephales promelas*, 62.32% of total number captured); sand shiners (*Notropis stramineus*, 16.64%); and red shiners (*Cyprinella lutrensis*, 12.14%). The four next most common fishes were speckled dace (2.43%), mosquito fish (*Gambusia affinis*, 1.85%), roundtail chub (1.16 %), and flannelmouth sucker (0.91%). This differed from 1999 sampling efforts in June/July where fathead minnows made up only 6.0% of total fish captured, while sand shiners were the most common fish captured (42.4%).

Estimated total numbers of fish per backwater varied from 17 to 2,495 (mean=421.6), using the ML estimate. This was significantly less than estimated total numbers during sampling efforts in June/July 1999 (19 to 9,930; mean=1,015). Fish biomass in backwaters varied from 0.02 to 36.80 g/m^3 (mean=3.06 g/m^3), also significantly less than fish biomass measured in June/July 1999 (0.5 to 2,427 g/m^3; mean=106 g/m^3). The amount of silt and algae in the backwaters and the low backwater temperatures found during sampling efforts

in March probably contributed to the lower numbers. While seining conditions improved and water temperatures increased in April, average fish biomass was actually less in April than in March (3.26 g/m^3 in March and 2.74 g/m^3 in April). The low numbers in April were partially caused by the rising water levels, which resulted in sampling relatively new backwaters (formed only a day or two prior to sampling) that had little time to be populated by fish.

Only six backwaters were sampled more than once, due to the fluctuating flow levels throughout the sampling period. One was sampled twice, three were sampled three times, and two were sampled four times. Total catch and catch rate of non-native and native fishes decreased in all backwaters between pass 1 and pass 2. Some increases and some decreases were seen between pass 2 and pass 3. For all backwaters, total catch and catch rates increased on pass 4, which was conducted 5 weeks later than pass 3. The relative abundance (% of total fish) of non-natives decreased slightly between passes in two backwaters and increased in all others.

Catch rates of non-native and native fishes in both the 15- and 18-mile reaches decreased in the first three passes, and increased in the pass 4 (Figure 1). However, there were no significant differences in catch rates between passes, except between pass 3 and 4 in the 15-mile reach. Pass 3 catch rate was 0, because only 4 backwaters were encountered: two were empty and two contained few fish, which were >50% natives.

Results of the depletion efforts were inconclusive for the second year. Results from 1999 efforts and 2000 efforts were similar, with only short-term, if any, effects observed. In both 1999 and 2000, on a reach basis, catch rates did decline between passes that were1-3 days apart. This might suggest some short-term effect of the depletion effort. Catch rates were much higher in pass 4 conducted 5 weeks later in 2000 in both reaches. In 1999, catch rates were higher on pass 4 in the 18-mile reach although pass 4 was conducted only a few days later than pass 3. However, since non-native fish were disposed of and natives were released, the similar patterns observed in both groups more strongly suggest that environmental changes had more effect on catch rates than depletion efforts. In 1999, a total of 2,344 native fish were caught and released, and 8,863 non-native fish were removed. In 2000, 342 native fish were released, and 7,054 non-native fish were removed.

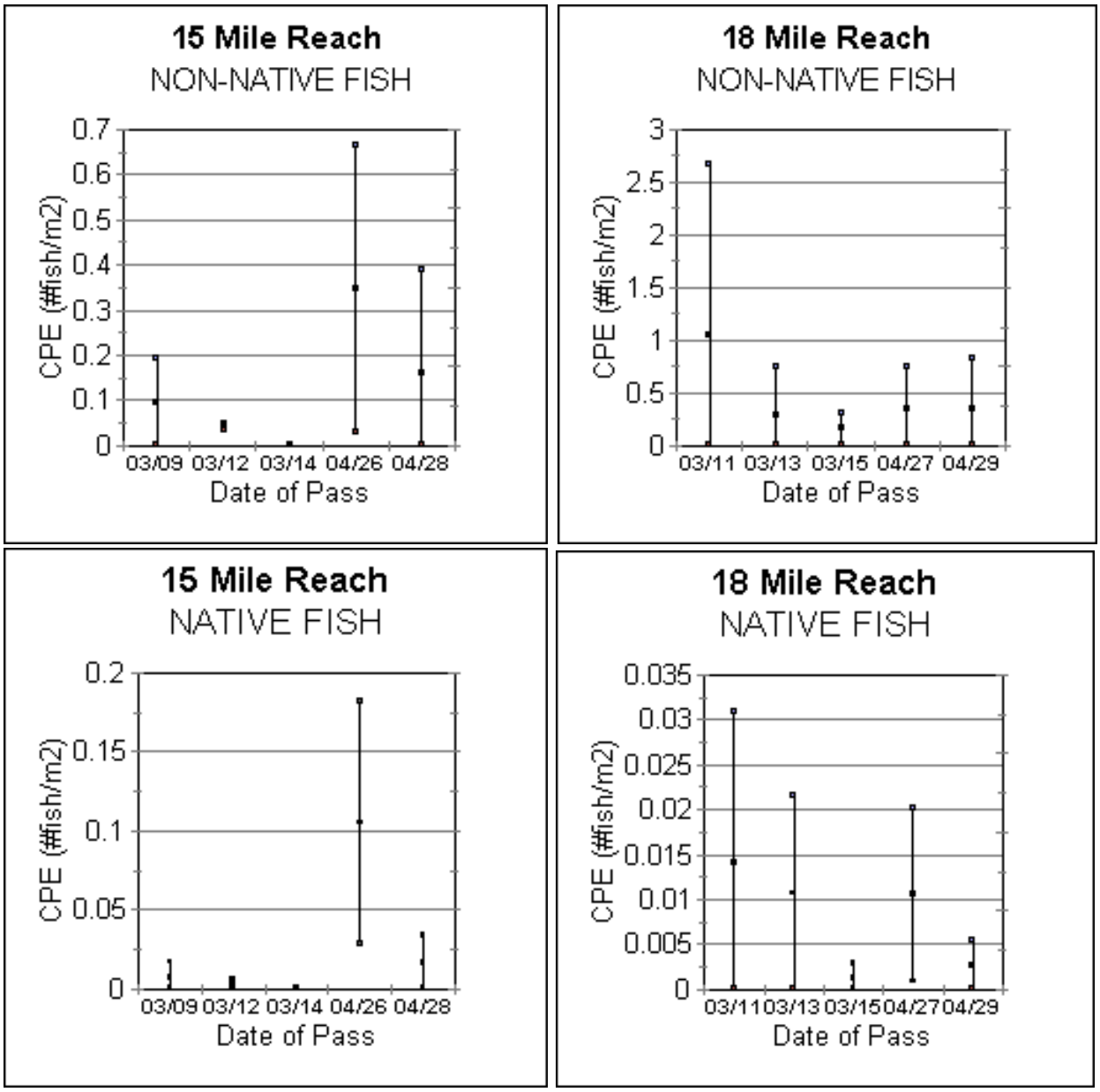

Figure 1. Catch rate of non-native fishes by sampling pass for backwaters of the 15-mile reach and the 18-mile reach. Arithmetic mean catch rates are shown with 95% confidence intervals. Note different scales on each reach.

Update of 1999 Results: Comparison with ISMP Results

Results of the 1999 removal efforts were compared with data from the ISMP. Removal efforts were conducted between the 1998 and 1999 ISMP sampling. ISMP results were evaluated between 1998 and 1999, and from 1986-present. A positive biological response

to this depletion sampling was evaluated using the standard abundance indices estimated from subsequent ISMP seine sampling in late September (Geometric Mean CPE in #fish/m^2). A positive response is defined as (1) increases in the total number of native fishes collected via ISMP; (2) increases in the relative abundance of each native fish species as estimated from ISMP sampling; (3) increases in areal seine catch rates for native fish species as estimated from ISMP collections; and (4) similar increases in numbers collected, relative abundance, or catch rates of age-0 Colorado pikeminnow within ISMP samples. These responses are evaluated individually below.

(1) The total number of native fishes increased between 1998 and 1999. However, the total number of non-native fishes also increased, and there was a relative increase in the three most abundant non-native cyprinids (NNC) (Table 3).

(2) The relative abundance of native species increased as an aggregate between 1998 and 1999 (Table 3). However, the relative abundance of native fish in 1999 (8.06%) was not significantly different from the mean relative abundance from 1986-1998 (6.01% ± 8.0, range 0.1% to 26.4%).

Table 3. Change in total numbers and relative percent of native and non-native fish, with NNC[1] as a subset of total non-natives, collected during ISMP sampling 1998 and 1999.

	Total numbers				Relative abundance		
Year	Native	Non-native	Total	NNC	% Native	% Non-native	% NNC
1998	9	1,876	1,885	1,531	0.48	99.52	81.22
1999	543	6,195	6,738	5,991	8.06	91.94	88.91

[1] NNC = fathead minnow, red shiner, sand shiner

(3) Areal seine catch rate (#fish/m^2) increased for native fish between 1998 and 1999 (from 0.01 to 0.17). However, catch rates for fathead minnow, red shiner, and sand shiner similarly increased. The catch rates for these species in 1999 were not significantly different from mean catch rates from 1986 to 1999 (Figure 2).

(4) Catch of age-0 Colorado pikeminnow did not increase. No Colorado pikeminnow have been collected during ISMP sampling in the 15- and 18-mile reaches since 1992.

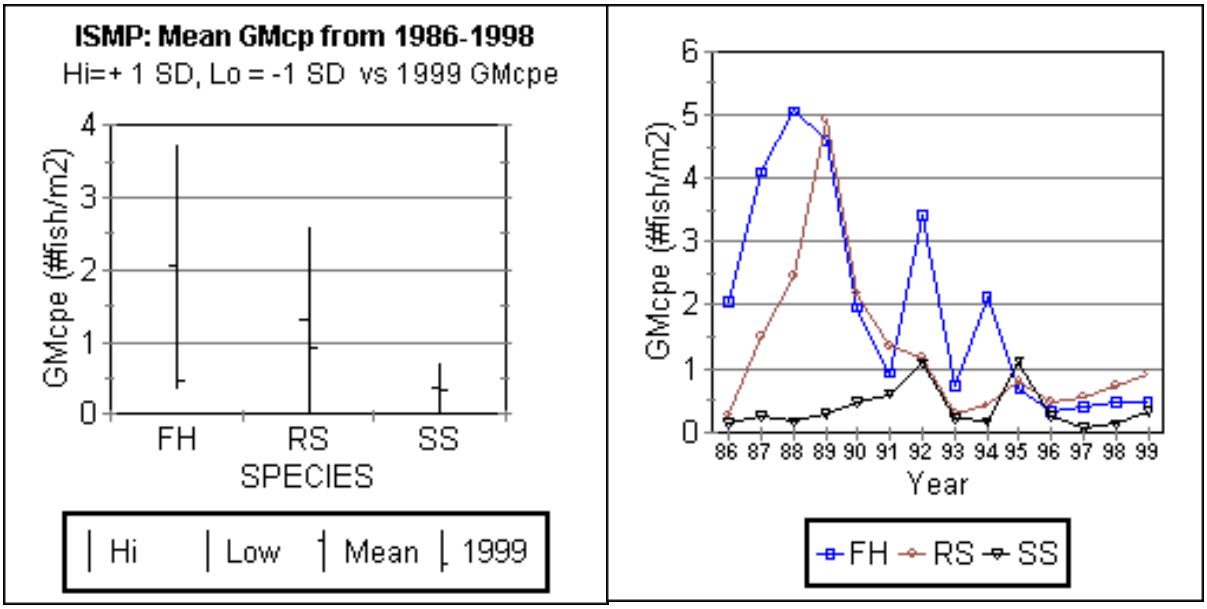

Figure 2 Comparison of GMcpe in 1999 with mean GMcpe of fathead minnow, red shiner, and sand shiner collected during ISMP sampling from 1986 to 1998 (adapted from McAda et al. 1998, and McAda, unpublished data).

Comparison of ISMP results from 1998 to 1999 were inconclusive. Although some increases in native catch and catch rate were seen, the 1999 values were not significantly different from mean values from 1986 to 1998. No significant conclusions can be drawn from these data, as they represent only one data point. The results of the 2000 depletion efforts will provide additional information which may allow more significant conclusions.

We note that densities of fathead minnows and red shiners during 1996-1999 were the lowest since 1987. This relatively low density of fishes may affect distribution and local abundances in backwaters and possibly catch rates. The effect of removal efforts may differ at higher densities of fish.

Data from the 2000 depletion sampling will be compared with data from the 2000 ISMP when those data become available. The ISMP sampling was conducted in late September and fish samples are being identified and processed at the Larval Fish Laboratory at Colorado State University, Fort Collins, Colorado. Results are expected to be available early in the year 2001.

VII. Recommendations

1. Conduct seining at relatively stable river flows with warmer water temperatures. For this study to properly evaluate seining as an effective removal method in the 15-mile and 18-mile reaches, seining of backwaters should take place when river flows are relatively stable at less than about 5,000 cfs. The low backwater temperatures and the amount of silt and algae in the backwaters makes March a poor month to conducting depletion sampling efforts. Flows during April are usually too high and/or variable. Two alternative schedules are possible:

a. Alternative 1. The best time for the most effective removal seining may be in late September and early October, which coincides with ISMP sampling. This schedule would conflict with ISMP, unless the efforts are coordinated. Since the numbers of age-0 Colorado pikeminnow are low in these reaches, combining these efforts during ISMP may be possible. We recommend a second team to work collaboratively with the ISMP team to conduct the first removal pass. A second pass can be conducted 1-2 weeks later.

b. Alternative 2. The purpose of the removal effort is to reduce the potential predation and competition between non-native and native fish species. Since removal efforts to date appear to be temporary at best, these efforts should be conducted prior to, but as close as possible to the time young native fish begin hatching and occupying backwater habitats, although conditions may not produce the most efficient removal. The appropriate time period would be on the descending limb of the hydrograph when the flows approach base flow, before peak spawning of native fish. This time period would vary by year, depending on the pattern of snowpack and snowmelt. For native suckers, including the endangered razorback sucker, this period would be in April/May. For Colorado pikeminnow, the time period would be late June to early July. Two separate removal efforts may be needed to target habitats and fish present: one before razorback spawning, and the other before Colorado pikeminnow spawning.

2. Evaluate seining as a removal method in other river reaches. The Colorado River near Grand Junction is a broad, cobble-lined channel that is characterized by large expanses of shallow-water habitats. This habitat mosaic allows fish to occupy many alternative habitats, making effective removal virtually impossible. Other river reaches, where backwaters are more defined with fewer alternative habitats, may be more conducive to this removal method. One significant determination from this study may be the recognition that seining as a removal method of small non-native cyprinids may be ineffective in broad, alluvial, cobble-lined channels.

3. Redirect removal efforts to other non-native fishes. If collaboration with ISMP is not feasible and if the determination presented in Recommendation 2 above is correct, it would be beneficial to redirect the efforts of this study to alternative methods of controlling non-native fishes. Capture and live removal of northern pike and channel catfish from the Yampa River has been identified as a possible effective means of removing that large predator from habitat occupied by the endangered fishes. Removal of centrarchids and channel catfish from the 15- and 18-mile reaches should be evaluated.

VIII. Project Status:

This project is scheduled to continue with seining of backwaters in the year 2001. The project is on track, except for the analysis described in Task 3, which will compare catch rates from this study with catch rates from ISMP sampling for the same river reaches. The ISMP data are expected to be available early in 2001 and will be analyzed and compared as quickly as possible; a comprehensive Annual Report will be submitted at that time. Funding needs for this study in 2001 should not change from the 2000 budget if similar seine

sampling is conducted.

IX. FY99 Budget Status:

	Budgeted	Expended[1]	Balance Remaining[1]
Task 1:	$36,523.00	$33,543.93	$2,979.07
Task 2:	$ 5,495.00	$ 3,560.00	$1,935.00
Task 3:	$10,000.00	$ 9,580.00	$ 420.00
Totals:	$52,018.00	$46,683.93	$5,334.07

[1]Amount expended and balance remaining do not reflect amount to be expended in analysis to compare data of this study with data from ISMP, when available in 2001.

X. Status of Data Submission:

Data will be submitted to the database manager with submission of this report. The data will include a spreadsheet with field-specific data entries taken from field data sheets similar to the ISMP field data sheets.

XI. Signed: Richard A. Valdez — December 18, 2000
Principal Investigator — Date

XII. References:

McAda, C. W., W. R. Elmblad, K S. Day, M. A. Trammell, and T E. Chart. 1998. Interagency Standardized Monitoring Program: Summary of results, 1997. Annual Report. Recovery Program for the Endangered Fishes of the Upper Colorado River Basin, U.S. Fish and Wildlife Service, Denver, Colorado.